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BIOLOGY.—*Biology and human trends.*[1]

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I

To discuss adequately in a brief address the assigned subject "biology and the social consequences of its advances" is plainly a large order, and one beset with considerable difficulties. For on the one hand biology as a science is still largely in the descriptive and historical phase of its development, and sociology is even more so, with the consequence that an account of the significant achievements of these sciences cannot be expressed in the concise and rational short hand that is so useful in physics; and, on the other hand, to appraise the theoretical consequences of scientific discoveries implies a certain skill in the dangerous art of prophecy. Not having any noteworthy aptitude as a prophet I can only put before you, in all modesty, the views of one biologist about some of the more evident relations between certain well-established biological facts and principles and some of the more characteristic features of the collective behavior of mankind. While I cannot speak with officially sanctioned authority for more than one particular biologist it does seem absolutely certain that just in proportion as any of the sciences, including biology, succeed in their effort to establish sound general principles and laws, just in that proportion will their advances be inevitably reflected in collective human behavior. The thoughts and actions of all mankind were permanently and irreversibly altered from what they were before, after the *Origin of Species* had been published in 1859. A corresponding alteration, more or less significant as the case may be, occurs whenever a *real* discovery in science is made, or a sound generalization established.

II

In the great Symphony of Life there appear to be three, and only three, main, basic biological themes, out of which come all the pleasant or harsh, useful or harmful, simple or complex counter-melodies,

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harmonies, and dissonances of the business of living. These main basic themes are:

First: The urge to individual personal *survival* here and now. This appears to be an attribute of all living matter.

Second: The urge to *reproduction* which again appears to be a property of all that lives.

Third: *Variability*, once more common to all living matter, in both its genetic and somatic aspects, the one leading to the observed differences or variations between individual organisms, the other embodying the differences in the same individual at different times in its life.

Finally, it is to be remembered that it is impossible to discuss or even to imagine life or living things without taking into account the rest of the universe in which they exist. So then we must add to our material for discussion one more item that corresponds roughly to the fiddles, flutes, horns, printed music, desks, and other *impedimenta* not musical *per se* but without which a symphony would never reach the ears. This item is:

Fourth: The *environment* that conditions and in some degree determines all vital phenomena.

Let us now examine each of these four items in some detail.

The urge to survival[2] may fairly be regarded as the most fundamental attribute of living things and is therefore placed first in the list. It may be well to point out at the start that in its essence this urge to survival is rather completely and uncompromisingly selfish. To the best of its ability the individual organism so conducts its affairs as to continue living just as long as possible, regardless of what other organisms may do or think about it. When extinction threatens, every resource is brought to bear to fend it off. Basically this is what underlies the struggle for existence. Out of it, associated with it, and because of it come great ranges of biological phenomena that we have, for combined reasons of convenience and pedantry, departmentalized: such as food getting, metabolism and nutrition, cellular and humoral defense mechanisms furnishing immunity and resistance to disease, protective shelter seeking and building, natural selection, and in good part evolution itself.

[2] There are curious aspects to this universal urge to individual survival. One of them is the biological uselessness of much of it. It would be extremely difficult, if not impossible, to find any rational biological purpose served by the survival of the individual after it has reproduced itself. Yet in not a few organisms, including man, there is normally a considerable part of the life span lived after adequate reproduction has been accomplished. Living grandparents, great grandparents and celibate clergymen are among Nature's gaudier examples of Thorstein Veblen's "conspicuous waste" in the realm of pure biology.

As a matter of observed fact this survival urge is primal and deeply rooted. Whenever and wherever we see its fundamental selfishness apparently in abeyance or even much abated, and seemingly replaced by altruism or "mutual aid" as it has been called, we may be sure, I think, that one or the other of two things has happened. Either, as among the invertebrates (especially the social insects) and the lower vertebrates, the "mutual aid" is not individually motivated but is a mechanistic group consequence of caste differentiation and integration, with no more (and no less) of an altruistic element in it than there is in the cellular differentiation and integration in the embryonic development of the individual; or, as in man and to some extent among his nearest relatives, complex psychological elements have been added to the picture in the course of evolution, which may seem at times to overwhelm and obliterate the more primitive and deeply rooted biological urge. The most obvious of these added factors amounts really to a more enlightened self interest—that is to say a belief that for the present and until times get much worse it will be likely to conduce more effectively to individual survival to play along with and help one's neighbors in the crowd.

This statement is, from the necessity of brevity, much too bald and apparently dogmatic in its form, and wants more explanatory elucidation and development than we shall have time to give it. But I think it essentially conforms to at least a part of the reality. It is reasonable to suppose that the individual soldier ant is unaware of the fact that its activities and efforts are of benefit to the social group (the colony) to which it belongs. On the contrary it seems likely that when it fights it does so because it is its inherent and entailed nature so to do. In fighting it is expressing its own will-to-live or urge to survival, and in the only way of which it is capable. On the human side, in thinking of the personal motivation of altruistic behavior I am always reminded of a speech of Brotteaux in *Les Dieux ont Soif*, perhaps the greatest novel Antole France ever wrote. It is (I quote from Allinson's translation): "What I am doing now, the merit of which you exaggerate,—is not done for any love of you, for indeed, albeit you are a lovable man, . . . , I know you too little to love you. Nor yet do I act so for love of humanity; for I am not so simple as to think . . . that humanity has rights. . . . I do it out of that selfishness which inspires mankind to perform all their deeds of generosity and self-sacrifice, by making them recognize themselves in all who are unfortunate, by disposing them to commiserate their own calamities in the calamities of others and by inciting them to offer help to a mortal resembling them-

selves in nature and destiny, so that they think they are succouring themselves in succouring him."

Man's behavior, and particularly his social behavior, is motivated by so complex a set of physiological and psychological factors, appetites, emotions, and reasons, as to be extremely difficult to disentangle in a particular instance. But it may safely be said that whenever he curbs his primal urge to personal survival, he does it for secondary reasons superimposed upon his natural, protoplasmic will-to-live. Many of these reasons are, collectively, what we call social. They represent purposeful adaptations in what Wheeler has convincingly argued is the next emergent level above the individual organismal. In most human beings these secondary social adaptations of behavior are still somewhat incomplete and imperfect, as clearly appears in times of great stress or danger. And the extent to which the highest forms of human altruistic social adaptations have real and enduring survival value, has yet to be measured. It can be argued with some plausibility that why they give the appearance of having some survival value, or at least of not being positively harmful, is because they became even moderately widespread only during that recent portion of human history in which living has been relatively easy for all mankind. It has been relatively easy for two reasons: Low density of population, in general; and rapidly increasing knowledge of applied science with its accompanying industrial developments. In a world where getting a living was easy, altruistic social relations were correspondingly easy. Instances and localities of a real struggle for existence between individual men (other than during large caliber wars or in the processes incident to the assumption of the "white man's burden") have been rare in this world since the beginning of the nineteenth century. And few have ever seriously alleged that war is an altruistic enterprise; nor is it at all uncertain that the pleasures of "civilizing" backward peoples are, like those of condescension, singularly one-sided.

The urge to reproduce is second in power, if at all, only to that for survival. This basic attribute of living material, like the other, includes in its scope great ranges of academically labeled and pigeonholed biological phenomena—of which among the more important are perhaps population growth with its part in the struggle for existence and natural selection; and heredity with its concomitants of development and growth. For heredity is most clearly to be apprehended as an aspect of reproduction. Living things do not merely reproduce; they reproduce *themselves*. This fact makes it clear that,

philosophically viewed, the urge to reproduction is really a part—an extension if you like—of the primal urge to survival. If the individual cannot ensure his own indefinite earthly immortality he can and does try *his* very best to see that his stirp shall keep on living forever and ever. Naturally this self-reproductive process tends towards social as well as biological stability.

Genes are almost incredibly stable and resistant to alteration in the natural and usual circumstances of life. For something over fifteen years there has been going on in my laboratory a continuous experiment designed to test this point in a simple and direct way. Tonight I make the first public statement about it. This experiment has now included over 300 successive generations—perhaps the longest bit of controlled breeding ever carried out, with the results in each successive generation carefully observed and precisely recorded. Allowing 30 years as a round figure for the average duration of a human generation the time equivalent in human reproduction of this experiment would be of the order of 9000 years—considerably longer than the total span of man's even dimly recorded history. The objective of this experiment with *Drosophila* has been to see whether a simple Mendelian ratio involving but one character would or could be altered in the passage of time by such natural forces as selection, different systems of breeding (such, for example, as that called "grading up" by livestock breeders), and wide alterations of the environment nearly up to the limits of the organism's ability to go on living at all. The plan of the experiment is a simple one. It started by crossing a normal fruit fly (*Drosophila melanogaster*) possessing the normal wings characteristic of the species, with the pure mutant form *Vestigial*, so-called because the wings are reduced to non-functional vestiges. This wing characteristic is associated with a single gene. In the next generation all the flies produced by the pair with which we started had normal standard wings, normal being dominant to vestigial. These flies of the first cross-bred generation were then mated to pure vestigials (back-crossed to the recessive parent, in technical genetic language) to produce the second cross-bred generation. Of the offspring of these matings approximately one-half had normal wings, because they carried the original normal wing gene, and the other half had vestigial wings, all this being in accord with regular Mendelian expectation. The vestigial winged flies of this and all later generations were killed and thrown away as soon as they had emerged and been counted. The normal winged flies were again mated to pure vestigials to produce the next generation. And so on with undeviating regularity for

more than 300 generations. What the plan means in briefest terms is that since the rather stupendously long time (measured in generations) when the experiment began the only hereditary determiner (gene) for normal wings that has ever been in the system is the one that was contributed by the one single normal wild type fly with which we started. All the normal winged flies now appearing in the populations of the successive generations of the experiment have normal wings only because their *Urgrossvater* had them 300 generations ago, and for no other reason.

The net result of the experiment has been to show that the gene involved has preserved its initial characteristics unaltered. So also has the cellular mechanism for the shuffling and sorting of the genes in each generation. The approximately 50-50 ratio of normal winged to vestigial winged flies appears generation after generation with somewhat wearisome regularity. The demonstration of the inherent stability of the genic mechanism of heredity that this experiment has given is extremely impressive.

Analogous phenomena of organic stability are observed in nature. There are considerable numbers of firmly established instances of organisms living today that are *specifically* identical with their progenitors in earlier geological eras. Among the Foraminifera one species (*Lagena sulcata*) has persisted unchanged from Silurian times down to the present; one species (*Globigerina bulloides*) from the Devonian to the present; two species from the Carboniferous; two from the Permian; four from the Triassic; seven from the Jurassic; and fifteen from the Cretaceous. The significance of these cases cannot be overemphasized. When it is comprehended that organisms now living have not changed by a perceptible amount from what they were millions upon millions of years ago in paleozoic times in those *minutiae* of structure upon which systematists base their specific distinctions and descriptions, the conservatism and stability of nature begins to be realized.

In human biology the conservative and stable element of true biological heredity is supplemented and reinforced by what has been variously called "social heredity," or tradition, or the mores of the group to which the individual and his stirp belong. This is, of course, not inheritance at all in a proper biological sense. It is rather an environmental matter at bottom. A born Englishman transported to America as a child may, and in fact usually does, come as a man to think and act like an American. But to make him do this if he lives his whole life in England among the people of his kind would be vir-

tually impossible. And it is a matter of statistical fact that vastly more human beings live out their lives not far from where they were born and among their kind of people, than migrate or are transplanted into realms of other traditions and mores. In consequence "social inheritance" or tradition plays an enormous, but usually underestimated part in determining the individual and collective behavior of human beings. Its effects have not infrequently been confused with those of true biological heredity. Masses of data have been collected to show that near relatives, particularly fathers and sons, frequently follow the same professions or callings. It is often quite erroneously concluded that such facts prove a biological inheritance of talent or ability, either in general, or for a particular calling, or both. Such data are inherently incapable of proving any such a conclusion. The observations can be much more simply and satisfactorily accounted for in the main by the operation of the purely environmental factors of familiar contact from childhood, training, easy opportunity of entrance, and the social pressure of tradition; in short by "social" not biological inheritance.

Our third unique and universal biological principle, variability, has two aspects, as has already been pointed out. No two living organisms are exactly like each other in all particulars, and no single organism is precisely the same at any two moments in its lifetime. The first of these aspects is the only one that is conventionally called variability. It is mainly caused by the combined interaction of genetic shufflings and recombinations and the environment. The second aspect of organic variability is usually and conveniently called adaptability. It is an odd and remarkable phenomenon. The unique thing is not that organisms are more or less fitted or adapted to the circumstances in which they find themselves. Inanimate objects of various sorts, and particularly that category of them that we call machines are this. It is true that the adaptations of organisms and machines are brought about in different ways. But the fact of adaptation is present, and in principle identical, in both. We are, however, not concerned here with adaptation, but with self-started and self-controlled *adaptability*, which organisms have and machines do not. Organisms incessantly change and alter themselves to meet the fleeting changes in their circumstances. No living organism ever stays put. When it does it is dead, and in dying has passed into a wholly different category of matter.

The process goes even deeper than change and adaptability in behavior. The very material substance itself that makes up the living

organism is constantly changing. What then does "personal identity" connote? What we are pleased to call the same identical man at the age of 70 years is composed of extremely little if any of the same material substance that made him up when he was 20 years old. Probably there is not a single molecule in him at 70 that was there at 20. In the intervening years the only thing about him that has survived is his *pattern*, a sort of transcendental or spiritual wraith through which has flowed a steady stream of matter and energy. There is a profound truth embodied in Cuvier's old comparison of a living organism to a whirlpool. It is the pattern that is the essence of the business. It alone endures. And it is constantly altering and adapting itself to changing circumstances. Especially is this true and important of the psychological panel of the total pattern of the human organism. It is this aspect of adaptability, the capacity of organisms for change ending only with death, that seems to be more important in its social consequences than its teleological aspect, if indeed we are prepared to admit the reality of the latter at all, as some are not.

We may conclude this hasty survey of basic principles with a word or two about the environment. The *effective* environment of any particular living organism is determined by the pattern of that organism, just as truly as the pattern of the organism is in part at least determined by the environment. For a particular man, and for a group of similar men, but not for any mouse, the relative honesty of his banker and the urbanity of his dean are highly important elements in the effective environment. And what makes them so is not the bankishness of the banker nor the deanishness of the dean, but the pattern of the particular man of whom we are speaking—a pattern not shared by the mouse. In short the relation between organism and environment is everywhere and always mutually reciprocal and as man is the most complicated and manifoldly diverse in his capabilities of all organisms, so also is his effective environment the most complicated.

More extensively and more effectively than any other organism he *makes his own environment.* He is constantly altering it in the hope of making it better. But such is the interplay of the contradictory biological elements in his nature that he dislikes and resists any alteration of his environment by anyone else than himself or the group of people similar to himself to which he belongs. The social and political consequences of these opposing attitudes are far-reaching and encompass within their range the greater part of our communal troubles in this imperfect world.

The full implications of the reciprocally determinative influences of

organism and environment seem to me to have been generally somewhat less than adequately valued in the last century's development of biological thought, and certainly an extremely inadequate amount of first-rate research has been put upon the matter. This is partly an obvious consequence of the trend given to biological philosophy by Darwin, Galton, Weismann and Mendel, with their emphasis upon the entailed or endowed element in the whole biological picture. In human biology particularly the rôle played by heredity has come to take on many of the aspects of religious dogma. Indeed it has been urged that eugenics should be overtly espoused and developed as a religion. And all this has been going on in a world where consciously planned and directed alterations of environmental conditions have had far-reaching and profound biological effects upon whole populations, not alone in the field of public health but in many others. Every geneticist knows that the final expression in the individual of each hereditary determiner is conditioned by the environmental circumstances under which its development is undergone. Yet very little has been done in the way of attempting to analyze thoroughly and penetratingly the biological effects of environmental conditions upon human beings.

In truth science, perhaps in common with all other modes of human thought, has a seemingly ineradicable tendency to crystallize its temporarily successful philosophies into dogma, and having accomplished the crystallization proceeds to the scourging of whatever skeptics and heretics may appear. Public health workers sometimes display a religious attitude toward their achievements as intense as the crusading zeal of the eugenists for their dogmas. Only a few hardy souls throughout history and at the present time seem able to realize for longer than brief periods that new knowledge is more often than in any other way engendered out of skepticism by hard work, and that religious attitudes and modes of thought for however noble a purpose enlisted not only have nothing whatsoever to do with science, but are the most effective hindrances to getting new knowledge yet heard of.

III

Let us now turn to the examination of some of the more conspicuous and far-reaching social consequences of the basic biological principles we have briefly reviewed. The three most obvious and important ones are, I think, that:

1. Man is enjoying better health and individually surviving longer

than ever before, likes it, and intends to go farther along the same road.

2. He is vaguely conscious of being more crowded than ever before, and finds the various consequences of this crowding increasingly unpleasant, but chiefly because it threatens that enhanced survival that is always his first and deepest biological concern.

3. Therefore he is groping about to find ways to alleviate the progressive overcrowding and preserve the health and survival gains he has made; trying a great variety of experiments, some of which are sensible, others highly dubious, and a few completely idiotic.

For the sake of clarity these three statements need a little expansion. The urge to survival is the ultimate biological motivating factor that has transferred the maintenance and improvement of health from an individual to a social concern. The gains in this field have been enormous. How enormous perhaps only a statistician can appreciate. This is not the place, nor is there any need, to go into the question of how they have been achieved. But the interesting thing about the case, broadly viewed, is that without the abatement by a single bit of that basic individual selfishness in which the biological urge for survival is rooted, it has been perceived that this urge can be most effectively served so far as health is concerned by making a social matter of a great part of it. Assuring a pure water supply and innocuously disposing of the waste matters of living are things that the individual simply cannot do well. Society can. And the social progression of the urge to survival in the field of health is by no means at an end yet. In two directions we may confidently look forward to great further changes and advances in the rather immediate future. In the first place, whether we or the physicians like it or not, it seems clear that the maintenance and improvement of *individual* health is going to become more and more completely a social matter. The basic reasons are two-fold, partly because of the continued normal evolutionary further growth of the same ideas and considerations that have brought us to where we are now regarding public health; partly because of economic and political considerations. The number of persons who at the present time get inadequate medical care because they cannot individually afford to pay for adequate (and lacking it endanger other peoples' health) is so large that as a group they are already in a position politically to demand and get necessary medical service, and may reasonably be counted upon shortly to do so. In the second place it seems reasonable to suppose that advances in medical science are going to continue. The last seventy-five years —an exces-

sively small fraction of mankind's earthly history—have witnessed more progress in knowledge of disease and its effective treatment and prevention, than was made in all the time that went before. And objectively viewed the rate of advance in medical discovery seems plainly to be accelerating rather than slowing.

Turning now to the consideration of the social consequences of the urge to reproduce it is immediately to be noted that the growing consciousness of overcrowding—too many people in the world for comfort—is not the resultant of such simple matters as lack of space in which to build dwellings or to move about, or of inability to produce food enough to satisfy the collective hunger. It is true that the total number of living human beings on the globe at this moment is probably something closely approaching two billion. But the gross land area of the globe is about 35 billion acres, so that on an equal parcelling each individual man, woman and child would have over 17 acres. If the total population of the earth were to be forcibly put upon the smallest of the continents—Australia—there would still be, on an equal division, well over an acre for each individual. Similarly relative to food whatever trouble there is relates to distribution rather than production. Such famines as occur now happen not because there is not enough food produced to feed everyone, but because the complex economic mechanism of getting it to the hungry works imperfectly.

The social consequences of population growth present a much more subtle and complicated problem than mere space or food. The suggestion just made that the total land area of the globe might be equally divided per head of population is an obviously fantastic one, with only a sterile arithmetic meaning. Not all the land is equally useful for sustaining human life either directly or indirectly. Some of it is of no use whatever. And this brings us to the crux of the population problem, which is that each unit of the population must somehow or other *get its living*. All other forms of life except man get their living by one or the other or a combination of two direct ways. These are (1) by preying upon other living things, plant or animal; or (2) directly converting inorganic materials into living substance. Man today gets his living by indirect processes conveniently labelled economic. He is in the main employed in doing things that he can trade with somebody else for the biological requisites for living. The population of the world has now become so large, and the discoveries and applications of science have made the producing of the things that can be traded so much easier than it used to be, that great numbers of people all over the world find themselves unable to get a living by this process

that was formerly so relatively simple. The rapid development of the industrial type of civilization in the nineteenth century made the gloomy prophecies of Malthus at its beginning look silly. The population grew at a tremendous pace when he thought its growth would be checked by want and misery. And people were having, by and large, a grand time while their number was increasing; because they were experiencing the enormous improvements in the physical comforts of living that came with the advance and applications of science. But these very factors, plus the enhanced survival rate coincident with the development of public health, caused the ugly spectre of unemployment to rear itself higher and higher until it has now become the most serious problem that humanity faces.

It is to be noted at this point that in modern civilization, as a normal consequence of the relation of individual man's biology to his age, approximately 50 per cent of all human beings have to earn the livings not only of themselves but also the major part of that of the other 50 per cent. Man develops slowly. Children are incapable of earning their own livings before they are about 15 years old, and have passed approximately a sixth of their total life span, and between a third and a fourth of their average life duration. At the other end of life, for the great majority of human beings over 50 years of age their living must come in whole or in considerable part either from the efforts of the active workers between 15 and 50, or from what they themselves were able to save while they were in their productively efficient ages. In practically all countries the sum of the numbers of persons under 15 and of those over 50, is almost exactly equal to the number of those between 15 and 50 years of age. But over and above this burden, that may fairly be called a normal biological one, the world's workers are now called upon to support the unemployed. A considerable part of the unemployed are so because they are unemployable—not sufficiently fit and able in a biological sense to make an honest living in a world organized as this one is. These unfit organisms are kept alive by the rest of society for no realistically demonstrable reason other than that they were once born, and by being born somehow placed upon the rest of mankind what has gradually come to be regarded as a permanently binding obligation to see that they do not die. The remainder of the unemployed are so because there are too many fit, able and employable people in the world to do the necessary world's work, the aggregate amount of which has been, is being, and will continue to be steadily reduced by discoveries and improvements in the sciences and arts.

Mankind is trying in several ways to meet this situation. The first and in the long run perhaps the most important way is by reducing its reproductive rate through the practice of contraception—birth control. It has been seriously alleged and with at least some justification, that even the admittedly imperfect techniques of contraception as they are now known constitute the most important biological discovery ever made. While historians of the subject attempt to show that the practice of contraception is almost if not quite as ancient as man's recorded history, actually the birth rates of large population aggregates did not begin to be sensibly affected by it until roughly the last quarter of the nineteenth century; that is to say since the beginning of the rapid development of the highly organized, integrated and urbanized industrial type of civilization. At the present time the effects of contraception on the birth rate are plainly apparent over large and leading parts of the world's population, and are growing at a rather rapid rate.

The practice of birth control is a thoroughly sound, sensible, and in the long run effective method of meeting the problem consequent upon the biological urge to reproduction operating in a universe of definitely limited size. The only objection of importance that can be urged against it is that it has led to an unfavorable differential fertility. The socially and economically more fortunate classes of mankind have practised contraception more regularly, frequently, and effectively than the less fortunate social and economic classes, with consequently reduced reproductive rates. It is contended that this has brought about a steady deterioration and degeneration of man as a species, and will continue to do so until all progress is stopped. After prolonged study of the matter it is my opinion that the alleged detrimental consequences of this class differential fertility upon the aggregate biological and social fitness and worth of mankind, while doubtless present in some degree, have probably been greatly exaggerated in the reformer's zeal to make his case. This is not the place, nor is there time, to state and document all the reasons that have led me to this view. But there are certain considerations that must be mentioned because they have been so consistently overlooked or suppressed. The first is the tacit assumption that lies at the very root of the argument. This assumption is that generally speaking and with negligible exceptions the more fortunate social and economic classes are in that position because they are composed of not only mentally, morally, and physically, but also genetically superior people. But it may be alleged with at least equal truth that these very people who

are regarded as mentally, morally, and physically superior are that way in no small part only because they and their forebears have been fortunate socially and economically. The analogy often drawn between human breeding and live stock breeding is in part specious and misleading. In animal breeding it has been learned that the only reliable measure of genetic superiority is the progeny test—the test of quality of the offspring actually produced. Breeding in the light of this test may, and often does, lead to the rapid, sure, and permanent improvement of a strain of livestock. But when the results of *human* breeding are interpreted in the light of the clear principles of the progeny test the eugenic case does not fare so well. In absolute numbers the vast majority of the most superior people in the world's history have in fact been produced by mediocre or inferior forebears; and furthermore the admittedly most superior folk have in the main been singularly unfortunate in their progeny, again in absolute numbers. No one would question the desirability of the free multiplication of people who are really superior genetically. But in human society as it exists under present conditions of civilization many a gaudy and imposing phenotype masks a very mediocre or worse genotype, and *vice-versa*. And most eugenic selection of human beings is, and in the nature of the case must be, based solely upon phenotypic manifestations.

Naturally it is to be understood that what has been said does not refer to the problem of the really biologically defective and degenerate members of society. There the eugenic position is sound and admirable in principle. The breeding of such people must be stopped; and by compulsory measures. Voluntary birth control will not help appreciably to the solution of the problem, for the persons concerned are not of a sort to make effective use of contraception. If all the contraceptive techniques in the world were made fully available to them they would still go on breeding. There are but three ways, all somewhat imperfect, of dealing with them; they must be segregated, or sterilized, or denied any aid in the struggle for existence and thus allowed and encouraged to perish because too unfit biologically to make livings for themselves with their own unaided resources.

One final point and I shall have done with this phase of our subject. It is a curious fact that at every stage of man's history from at least the time of Plato, and indeed of Theognis of Megara a century before that, there have been those who have been just as certain as some present day eugenists are, and just as deeply grieved, that mankind was going rapidly to the dogs because the right kind of people

were not breeding enough and the wrong kind of people were breeding too much. Perhaps men are nearer the dogs now than they were in the Alexandrian age; but I venture to doubt it. The evidence seems to me overwhelming that mankind is, on an average, mentally, morally, and physically much superior today to what it was when Socrates was abated as a public nuisance.

So much for birth control and the eugenic objections to its alleged consequences. We turn now to the most ineffective, cruel, and altogether foolish large scale method by which society tries periodically to ameliorate the consequences of the biological urge to reproduction, namely war. If this characterization is reasonably in accord with reality why do we go on having wars? The reason has been stated with precision by a clear thinking human biologist, C. C. Walker, in the following words:

"The natural striving after security by one people, that is to say its natural endeavors to exist, must affect the security of other peoples. Because when a people endeavors to ensure its existence, by reason of its automatic reactions to the problems connected with food-supply, security, and social stability, its endeavors will conflict with the strivings of other peoples who are also subject to the same environmental problems. Each people is only trying to exist. When a people considers that its existence is threatened by a particular environment, . . . to such an extent that no adaptation to the environment will suffice, it is forced to attempt to alter that environment. But other people may consider that any alteration of that environment affects its own existence. The result is war."

Is there any reason to suppose that this biologically natural process, with its characteristic of almost rhythmic recurrence, will ever come to an end? It seems to me there can be such a hope only in the long —very, very long—run. And the only reason I can see for even this deferred hope is the already great and rapidly increasing ease, speed, and cheapness of transportation and communication between all parts of the world. The slow but steady and sure biological effect of easy getting about will inevitably be more and more interbreeding, with a gradual lessening of the racial and national differences between human beings. In the far-off end all mankind will presumably be a rather uniform lot; all looking, thinking, and acting pretty much the same way, like sheep. National or racial isolation has even now become extremely difficult to maintain; indeed in a quite literal sense the attempt to maintain such isolations already threatens group survival in not a few instances. In the long run they cannot and will

not be maintained. Just in proportion as they diminish so will the frequency of wars diminish. But the diminution seems likely to be at a fearfully slow rate; it will be a long time yet before the *last* war is fought. And a low cynic might suggest that even war, horrid and stupid as it is, would be preferable to that deadly uniformity among men towards which we are slowly but surely breeding our way.

Society here and abroad is just now experimenting with a whole series of internal readjustments that are being forcibly imposed upon temporarily dazed but always adaptable populations, in the hope that out of them will come a real and permanent solution of the problem that man's urge to reproduction has saddled upon us. All of these experiments appear to fall into a few simple categories when realistically examined. They all stem from and put into practice one or the other of two ideas, neither of which finds unqualified support in the science of biology. The first of these ideas is that it is best to let one individual in a group run the group's affairs; permanently, absolutely and without interference, on the philosophy that averaged opinion and averaged action are as stupid, inefficient and unreal as an averaged egg is innutritious and unreal. The other and opposite idea is that it is best to have the whole group run the business as a whole, allowing no individual any powers except as a merely mechanical executor of the group's will, on the philosophy that no individual is really superior to another and that therefore in averaged opinion and action wisdom alone resides. In their practical implementation, performance, and effects both ideas turn out to be singularly alike. Both alike scorn the intermediate idea of true democracy. And finally both attempt to solve the problem that is pestering the world by a simple procedure universally regarded as criminal when practiced by an individual. It is that the more abundant life is to be assured to a too abundant people by stealing goods from the prudent and efficient, and then giving them to the imprudent and inefficient. Since there are always a great many more of the latter kind of people than of the former this turns out temporarily to be the most effective political device ever heard of. Whether it will prove to be so permanently is less certain. It has been pointed out earlier in this paper that adaptable as man is there are nevertheless elements of conservative stability in his biological make-up whose roots go back to the very beginning of his evolution. And in that perfect state of society envisaged by our major prophets, where "economy of plenty" will assure, as we are told, that no one will have to work *much* for a living, and where the higher philosophy that holds "human rights above property rights"

(without perhaps clearly understanding what it means by either) assures that in any event everybody shall be kept alive at public expense whether he works or not, is there not the barest possibility that there might appear a somewhat general inclination on the part of the more intelligent members of the group to opt for the philosophy rather than for the communal work (however slight in amount)? If anything like this should happen might not the economy of plenty some day find itself once again in a parlous state of unplenty? Not being myself a dependable prophet I venture no answer. But in any case, and regardless of details, it is difficult to convince a biologist that a social philosophy will endure for any great length of time that deliberately and complacently loads upon the always weary backs of the able and fit an evergrowing burden. If there is one thing certain in the science of biology it is that no species or variety of plant or animal has long survived that was intrinsically incapable of making its own living. There is *somewhere* a biological limit to altruism, even for man. A large part of the world today gives the impression that it is determined to find the exact *locus* of that limit as speedily as possible.

IV

Up to this point the discussion has been of the social consequences of firmly established biological principles. In what regions of biology may there be expected with some confidence developments new in principle, and with important implications for human behavior, thought, and social relations? Probably not, one is fairly safe in saying, in such fields as morphology, embryology, or taxonomy. The advances in the field of genetics, which has to a considerable degree dominated biological thought during nearly a half century and will probably continue to for some time yet, will inevitably have an increasing influence on human affairs as the meaning of its advances is better understood. But this influence seems on the whole likely to be more of a negative than positive character—a matter of avoidances, taboos, and prohibitions rather than of positive contributions to human biological progress. Heredity represents the entailed side of biology—things given—about which it is extremely difficult really to *do* anything effective in the face of other compelling elements of human life and living, especially those elements belonging in the psychobiological realm.

It seems probable that advances likely to be made in physiology and psychobiology may profoundly alter human affairs and outlooks

in the not very distant future, and particularly in the direction of the greater release and more effective control of the energies and potentialities of man (and of other living things at will). In recent years the investigations and deductions of the psychiatrists, endocrinologists, and psychobiologists have thrown a beginning glimmer of real light upon the underlying biological bases of the activities and conduct of living things, and especially of man. We are beginning to understand in some detail and particularity how, conduct, normal and abnormal, moral and immoral, is the expression of "animal drives" or urges—themselves resultants of subtle chemical and physiological changes in the body—rather than of either free will or terrestrial and heavenly precepts. It does not seem extravagant to expect that as this understanding broadens and deepens ways may be found to bring it about that men will act somewhat more intelligently and less harmfully in politics, business, society, religion, and elsewhere generally, than they sometimes have in the past. The ever widening and deepening flow of biological knowledge is plainly furnishing a solid, scientific groundwork for a philosophy of life based on releases, in contradistinction to the philosophy of life based upon inhibitions and prohibitions that has so long held us enthralled. I am not unaware that current political philosophies in various parts of the world look backward in this regard, and insist on more prohibitions and regimentations. But they are going against biology, and if I read the history of evolution aright, biology will win. Nature is never in a hurry. And that odd bird the Blue Eagle was much shorter lived than even the poorest dinosaur.

This current trend of biology of which we have just been speaking has many different aspects. There are some who will recall the widespread interest and discussion stirred up many years ago by an essay of the late William James entitled *The energies of men*. It dealt with the release of normally untapped and unsuspected potentialities of men under certain conditions, sometimes those of shock and stress, sometimes under the impulsion of the will. Examples were given of men who, though enfeebled by poor health, performed feats of strength and endurance that would tax the finest athlete, when they encountered conditions that imperatively demanded such a performance.

We are working in the laboratory on another angle of the same general problem. We have experimented with seedlings, grown under very exactly controlled conditions such that all the matter and energy for growth and living (save for water and oxygen) come from the nutri-

tive materials stored in the cotyledons of the seed planted, which themselves are an integral part of the plant. Under these experimental conditions the seedling goes through a complete life cycle of germination, growth, adulthood, senescence, and eventual death. This life cycle corresponds quantitatively very closely to the normal life cycle of the plant in the field, except that it is greatly compressed and fore-shortened in time. By appropriate aseptic surgical procedures we have removed carefully measured parts of the food resources stored in the cotyledons of the cantaloup seeds we have used, and then observed the relative performance of such mutilated seedlings as compared with the normal controls, in respect of growth and duration of life. The net result is to demonstrate that the mutilated plants grow much larger and live many times longer, as compared with the normal controls, than they would be expected to in proportion to the amount of matter and energy for living available to them after the operation. The results indicated clearly that the operated seedlings utilized their available food resources much more effectively than the normal plant does. It is as though an inhibitor had been removed from the plant, freeing its potentialities for more adequate expression.

The possibilities suggested by these experiments seem far-reaching, though admittedly the exploration of the field has only just begun. Work in this direction on plants and lower animals may result in such an understanding of the physiology of releasing normally inhibited biological potentialities as to enable man to unleash effectively and usefully more of his own energies.

In the field of human biology the admitted and crying need is for adequate synthesis of existing knowledge. It is an obvious truism that we know more in detail about the biology of man than about that of any other organism. Anatomists, physiologists, anthropologists, psychologists, sociologists, and economists, have by analytical methods piled up a body of detailed information about man that is literally colossal. But what does it *mean* for humanity? Every thoughtful person will admit that there is a kind of moral necessity to go forward in the attempt to get a better and more comprehensive understanding of the whole nature of man. The material, mechanized civilization he has evolved may easily become a monster to destroy him unless he learns better to comprehend, develop, and control his biological nature. If inventions and discoveries cannot be intelligently managed after they are made, they are likely to be a curse rather than a blessing.

The bulk of scientific effort is, and always has been, directed to-

wards analysis unaccompanied by synthesis. Scientific men have mainly left it to philosophers and literary men to be the synthesizers of their data, shirking the task themselves with a few notable exceptions, of whom perhaps the greatest was a biologist, Charles Darwin. But analysis at best leads only to knowledge; while synthesis may furnish wisdom. And mankind sorely needs more wisdom right here and now!

PHARMACOLOGY.—*The toxicity for sheep of water solutions of hydrocyanic acid and the effectiveness of the nitrite-thiosulphate combination as a remedy.*[1] JAMES F. COUCH, A. B. CLAWSON and H. BUNYEA, Bureau of Animal Industry.

The results of a considerable number of experiments in which solutions of potassium cyanide were administered to sheep have previously been reported.[2,3,4] The potassium cyanide was administered as a drench and the quantity given in each base recorded as milligrams per kilogram of animal weight. In these experiments information was obtained concerning the smallest quantity of potassium cyanide that will produce symptoms in sheep, the smallest quantity that will kill and also concerning the effectiveness of a combination of sodium nitrite and sodium thiosulphate as a remedy for animals poisoned by potassium cyanide.

In the present paper data are presented concerning the toxicity for sheep of hydrocyanic acid in water solution and the remedial effectiveness of the nitrite-thiosulphate combination.

The solution of hydrocyanic acid used was prepared by mixing cold solutions of the calculated quantities of potassium cyanide and of tartaric acid in water and filtering off the precipitated potassium acid tartrate which was washed with a little cold water. The filtrate and washings were combined and diluted to a definite volume. The cyanide content of the solution was then determined by titration with N/10 silver nitrate solution and the strength was adjusted so that one cubic centimeter of solution contained 15.5 mg. of hydrocyanic acid. The solution contained less than 0.05 per cent of dissolved potassium acid tartrate which, in the doses given, was negligible.

A fresh solution was made each morning before experimental work, although analysis showed that there was no appreciable change in the strength of the solution when preserved for 72 hours in a cold place.

[1] Received February 28, 1935.
[2] This JOURNAL **24**: 369–395. 1934.
[3] This JOURNAL **24**: 528–532. 1934.
[4] This JOURNAL **25**: 57–59. 1935.

TOXIC AND LETHAL QUANTITIES

In all, 29 experiments were made on 20 sheep. In 17 of these no remedies were administered, the experiments being made primarily to determine the effects of various quantities of hydrocyanic acid as compared with those produced by potassium cyanide. The general results obtained in the 17 cases are shown in table 1.

TABLE 1.—QUANTITIES OF HYDROCYANIC ACID GIVEN TO SHEEP AND THE EFFECTS PRODUCED WHEN NO REMEDIES WERE USED

Date 1935	Sheep		Quantities[a] given mg./kg. and effect			
	No.	Weight kg.	Symptoms	Sickness	Death	Remarks
Jan.						
14	1451	34.47			3.38	
14	1462	38.55			3.10	
14	1460	41.72			2.75	
14	1461	43.54			2.74	
14	1463	38.55			2.65	
14	1459	43.99			2.64	
14	1465	33.11			2.63	
14	1452	49.89			2.55	
14	1458	41.72			2.41	
16	1456	35.37			2.32	
18	1474	37.64		2.31		A very poor sheep
14	1464	48.98			2.29	
14	1457	34.92	2.27			
14	1454	46.49		2.03		
14	1453	36.73		1.71		
14	1455	30.84	1.36			
14	1456	35.37	1.05			Very slight effect

[a] The quantities are given as milligrams of hydrocyanic acid per kilogram of animal weight.

The effects produced on sheep 1456 by 1.05 mg. per kg. of animal weight were so mild that the quantity for this animal was apparently very close to the minimum toxic dose. The fact that 2.29 mg. killed while 2.27 mg. produced only symptoms indicates that 2.29 mg. is the approximate minimum lethal dose for sheep. That 2.31 mg. did not kill sheep 1474, a very poor, underweight animal, is not considered as valid evidence against this conclusion. Were the dosage for this animal based on its normal weight when in good flesh, it would be much lower than the figure considered as the minimum lethal dose.

To compare, on a common basis, the toxicity of hydrocyanic acid with that of potassium cyanide, the dosages of the two substances may be reduced to the cyanide (CN) equivalents. On this basis the toxic and lethal doses of cyanide in the two forms are essentially the same.

Following the administration of hydrocyanic acid in 29 cases, symptoms appeared in from 20 seconds to 2 minutes, the average time being 50 seconds. The time to prostration or collapse varied more widely, it being 50 seconds in the shortest case and 51½ minutes in the longest. The longest period was with a sheep given slightly more than 1 m.l.d. Twenty-three cases had an average time of 5 minutes 52 seconds. In the average the animals given the larger quantities showed symptoms and collapsed in a shorter time than those given the smaller doses.

The average time to symptoms in the sheep given 3 to 4 lethal doses was 42 seconds; with those given 1 to 1.5 lethal quantities, it was 55 seconds; and with sheep given toxic but sub-lethal doses, 56 seconds.

The average period to collapse in those sheep given from 3 to 4 lethal quantities was 1 minute 31 seconds, while with those given less than 1.5 minimum lethal doses it was 9 minutes 13 seconds. The longer average was due in part, but not entirely, to the inclusion of two resistant and somewhat unusual cases.

Of the sheep which received no remedy, 11 died. The time between the drenching with cyanide and death varied between 12.5 minutes and 1 hour 22 minutes, and averaged 37 minutes 50 seconds.

RESULTS OF THE ADMINISTRATION OF THE REMEDY

To test the effectiveness of the nitrite-thiosulphate combination as a remedy in cases of poisoning by hydrocyanic acid, 12 experiments were made on 10 sheep. For experimental use a water solution containing 1 gram of sodium nitrite and 2 grams of sodium thiosulphate per 15 c.c. of solution was prepared. Based on 2.29 mg. per kg. as the minimum lethal dose, these animals were given doses of hydrocyanic acid ranging from 3 m.l.d. to 4.0 m.l.d. In periods varying from 0.8 to 4 minutes after being drenched with the cyanide they were then injected intraperitoneally with 15 c.c. of a solution of the nitrite-thiosulphate combination as a remedy.

The results of the administration of the nitrite-thiosulphate combination are shown in table 2.

In 10 cases the remedy was given after the animals had collapsed. Of these, six (or 60 per cent) recovered. One sheep was given the remedy as soon as symptoms were apparent and before collapse, and one was treated at the time of collapse. Both died.

TABLE 2.—SHOWING THE EFFECTS OF THE NITRITE-THIOSULPHATE COMBINATION ADMINISTERED INTRAPERITONEALLY AS A REMEDY FOR SHEEP POISONED BY HYDROCYANIC ACID

Date 1935	Sheep		Dose m.l.d.	Time from drench—			Effect
	No.	Weight kg.		To first symptom	To collapse	To giving remedy	
					Minutes		
Jan.							
16	1457	34.92	3.	0.5	1.3	1.8	Recovery
14	1469	43.99	3.	1.0	1.5	2.	do
16	1470	43.54	3.	1.0	1.8	2.7	Death
17	1466	35.83	3.1	.5	1.3	1.75	do
17	1469	43.99	3.25	.8	1.5	2.5	Recovery
17	1473	40.82	3.25	.75	1.75	2.	Death
17	1457	34.92	3.25	.5	2.2	4.	Recovery
17	1453	36.73	3.50	.7	1.	1.5	do
17	1455	30.84	3.50	.7	1.75	2.	Death
17	1454	46.49	3.75	.75	2.	2.	do
17	1474	37.64	4.	.5	1.	1.5	Recovery
17	1475	40.82	4.	.8±	1.8	.8	Death

For the sake of comparison with the results obtained using the same remedy for sheep poisoned by potassium cyanide as given in a former paper,[5] table 3 is included. This is a summary of table 2. In it the doses of hydrocyanic acid are arranged in classes, and the number of survivals and deaths in each class shown.

TABLE 3.—EFFECTIVENESS OF THE REMEDY AGAINST VARYING QUANTITIES OF HYDROCYANIC ACID

Dose of HCN m.l.d.	Number of animals	Number that survived	Number that died	Per cent survived
3	4	2	2	50
3.25	3	2	1	67
3.5	2	1	1	50
3.75	1		1	0
4	2	1	1	50
Total	12	6	6	50

From table 3 it will be noted that the remedy was 50 per cent effective against as much as 4 minimum lethal doses of hydrocyanic acid. When compared with the results obtained with sheep poisoned by potassium cyanide, in which 2.75 m.l.d. was the largest dose against which protection was secured in 50 per cent or more of the cases,[6] it would appear that the remedy is more effective against poisoning by hydrocyanic acid itself than against poisoning by potassium cyanide.

[5] This JOURNAL 24: 369–395. 1934.
[6] This JOURNAL 24: 369–395. 1934.

SUMMARY

When administered in sheep in a drench the minimum toxic dose of pure hydrocyanic acid is shown to be approximately 1.05 mg. per kg. of animal weight, and the minimum lethal dose is approximately 2.29 mg. per kg. When compared on a cyanide (CN) basis the differences in toxicity between hydrocyanic acid and potassium cyanide are slight and well within the limits of experimental error.

Following the administration of pure hydrocyanic acid, symptoms appear in an average of 50 seconds. The time to collapse is very variable. In the cases here reported the average time was 5 minutes 52 seconds. When no remedy was given the average time to death was nearly 38 minutes.

The nitrite-thiosulphate combination was 50 per cent effective as a remedy against from 3 to 4 m.l.d., and when injected intraperitoneally within 4 minutes after the hydrocyanic acid was administered.

GEOLOGY.—*Notes on the structure of the Erin shale of Alabama.*[1] C. F. PARK, JR., U. S. Geological Survey. (Communicated by W. W. RUBEY.)

ABSTRACT

The Erin shale of east-central Alabama has previously been mapped as a stratigraphic unit in the Talladega slate. Fossils found in the Erin shale have been the basis for assigning a Carboniferous age to part or all of the Talladega slate and other crystalline rocks in the eastern part of the State. Evidence is presented to show that the contact between the Erin shale and the Talladega formation is a thrust fault dipping at a low angle eastward. The Erin shale is exposed by erosion through the overthrust block.

The type locality of the Erin shale of east-central Alabama is an area about 6 miles long and less than 1 mile wide. The exposure is in the valley of Talladega Creek along the east base of the Talladega Mountains in Clay County, Ala., about 8 miles northwest of Ashland. The Hillabee chlorite schist and the Ashland mica schist lie east of the Talladega formation (fig. 1). The Wedowee formation is east of the Ashland schist but is not shown on the map.

The Erin shale was described in 1903 by E. A. Smith, who considered it a lenticular mass in the Talladega slate, which he called "Ocoee."[2] Fossil plants were collected by Dr. Smith from the Erin shale and were determined by David White to be of Carboniferous age. Practically all papers treating of the Talladega slate that have appeared since 1903 have assigned a Carboniferous age to at least

[1] Published by permission of the Director, U. S. Geological Survey. Received March 30, 1935.

[2] SMITH, E. A. Science, new ser., 18: 244–246. 1903.

part of the formation, on the assumption that the Erin shale is stratigraphically enclosed in the Talladega. As a result of study of the relations between the Talladega formation and the crystalline rocks to the east (the Hillabee schist, the Ashland schist, and the Wedowee formation) the several crystalline formations have been assigned to periods ranging from pre-Cambrian to Carboniferous.[3]

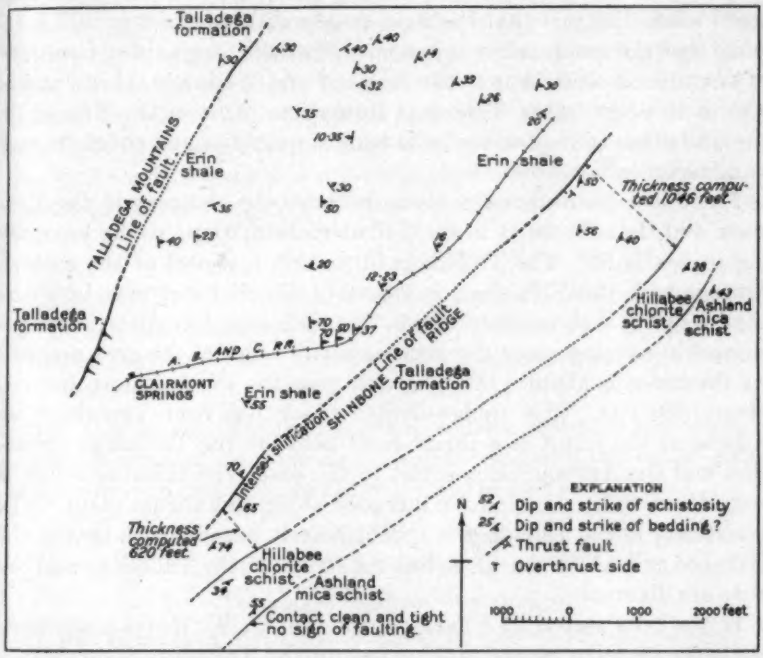

Fig. 1.—Sketch map of part of the Erin shale, showing relation to the Talladega formation.

Slightly altered Erin shale is exposed in numerous cuts along the Atlanta, Birmingham & Coast Railroad. This shale is a fine-grained black material that in thin sections shows a few small grains and bands of fine quartz in a carbonaceous matrix. Nothing is seen that would indicate that the rock had been metamorphosed except the

[3] PROUTY, W. F. *Geology and mineral resources of Clay County, Ala.* Alabama Geol. Survey County Rept. 1: 38–41, 61–63. 1923; *Age of Talladega slates of Alabama.* Pan-Am. Geologist. 37, n. 5: 363–366. 1922.

ADAMS, G. I. *Geology of Alabama.* Alabama Geol. Survey Special Rept. 14: 30, 33, 36–39. 1926.

BUTTS, CHARLES, idem, 59–61, 217–219.

BROWN, J. A., *Graphite deposits of Ashland, Ala.* Econ. Geology. 20: 208–229. 1925.

shale parting planes; no evidence of recrystallization is found. The Talladega formation is, by contrast, a thinly laminated schist composed almost entirely of sericite and quartz with a little chlorite; it is much more intensely metamorphosed than the Erin shale and appears to be almost entirely recrystallized. Both the Erin shale and the Talladega formation weather to a white or buff clay, but the outcrops of weathered Talladega schist generally contain some partly altered mica. The fact that the Erin shale weathers white or buff indicates that the carbon present has not been fixed as graphite. Graphite is a common constituent of the Ashland and Wedowee schists and is known to occur in the Talladega formation. West of the Erin shale the Talladega formation contains beds of quartzite and conglomerate in addition to the schist.

There is a discordance in strike between the cleavage in the Erin shale and the schistosity in the Talladega formation, locally amounting to nearly 90°. The Talladega formation just east of the eastern contact with the Erin shale is intensely silicified and rises in a cliff that in places is about 30 feet high. The Talladega formation is wedge-shaped in outcrop; near the northeastern border of the area mapped its thickness is about 1,000 feet and near the southwestern border, about 600 feet. This wedge-shaped block has been explained by Adams as the result of a thrust fault between the Talladega formation and the Ashland mica schist to the east. The Hillabee schist is considered to be a basic rock intruded along this thrust plane.[4] The schistosity in the Talladega is approximately parallel with that in the Hillabee and Ashland schists, but the strikes in the Talladega and the Erin are divergent.

It has been stated by Charles Butts that C. W. Hayes considered the Erin shale to be an infolded bed in the Talladega slate. Butts' notes, however, indicate a fault along the southeast contact of the Erin shale and the Talladega slate, but he states that Hayes' interpretation seems equally probable.[5] C. W. Hayes and David White concluded, after field study, that the Erin shales were unconformable with the Talladega slates.[6] Miss Jonas has recently described and mapped the Erin shale as a fenster in the Talladega slate but does not discuss it in detail.[7]

[4] ADAMS, G. I. op. cit., p. 38.

[5] BUTTS, CHARLES. Personal communication, January, 1935.

[6] MCCASKEY, H. D. *Some gold deposits of Alabama.* U. S. Geol. Survey Bull. **340**: 38. 1908.

[7] JONAS, A. I. *Structure of the metamorphic belt of the Southern Appalachians.* Am. Jour. Sci. **24**: 243. 1932. Geological map of the United States, southeastern quarter. U. S. Geological Survey, 1934.

There is sufficient evidence to indicate a fault between the Talladega formation and the Erin shale in this area. The evidence also justifies the suggestion that the Talladega formation has been thrust over the Erin shale along a fault plane that dips slightly eastward (3°–5° as determined by differences in altitude along the contracts). The Erin shale is thought to have been exposed by erosion of the thin overthrust plate, thus forming a window. The faulting along the line of outcrop of the Hillabee schist is considered a complementary thrust fault in the overthrust block. The mineralization along the fault in the Hillabee schist is therefore thought to be post-Erin shale. The assignment of part of the Talladega slate and other crystalline rocks in eastern Alabama to an age as recent as the Carboniferous, on the supposition that the Erin shale is a lenticular mass originally deposited in the Talladega, is believed to be unwarranted by the field relations here described.

ENTOMOLOGY.—*Three new reared parasitic Hymenoptera, with some notes on synonymy.*[1] C. F. W. MUESEBECK, Bureau of Entomology and Plant Quarantine. (Communicated by HAROLD MORRISON.)

The new species described below have been reared in the course of studies in economic entomology. In order to make the names available for use the descriptions are published at this time.

SERPHOIDEA

SCELIONIDAE

Telenomus catalpae, new species

In the female sex very similar to *sphingis* Ashmead, but distinguished by having the occipital carina only very narrowly interrupted at the middle, by the yellowish mouth region, and by the somewhat stouter thorax. In the male sex at once distinguished from all related species by the entirely reddish-yellow head and thorax.

Female.—Length, 1 mm. Head transverse, more than twice as broad as long; viewed from in front much broader than long; eyes finely hairy, rather strongly divergent below; frons smooth, delicately reticulated laterally below middle of eyes; malar space half as long as scape; vertex finely reticulate, punctate and subopaque; ocelli in a low triangle, the lateral ones touching the eyes; temples flat, polished except for a narrow reticulated border along the eyes; antennae 11-segmented; scape not reaching summit of vertex; pedicel at least one-third as long as scape; first segment of funicle distinctly a little shorter than pedicel; second and third segments of funicle subequal, shorter than first and barely or not longer than broad; fourth shorter than second or third and about as wide as these; fifth to ninth seg-

[1] Received March 20, 1935.

ments forming a distinct club, the fifth much the smallest, strongly transverse and somewhat narrower than the following; sixth, seventh and eighth subequal, distinctly somewhat broader than long, the apical segment conical.

Thorax narrower than head; mesoscutum evenly convex, minutely reticulate punctate, finely hairy and subopaque; scutellum smooth and polished; metanotum finely sculptured and opaque at the middle; propodeum with a prominent oblique carina on each side from near middle of base of propodeum to a point beyond middle of lateral margin; stigmal vein more than twice as long as marginal and about half as long as postmarginal; submarginal vein with about 10 long setae.

Abdomen hardly shorter than thorax and nearly as broad, more or less truncate at apex; first tergite four times as broad as long at the middle, smooth and polished except for a row of elongate pits bordering the basal margin; second tergite about one and one-half times as long as broad, smooth and polished except for a row of foveae at the base and a few weak short striulae medially at base; remaining tergites very short; ovipositor sheath slightly exserted.

Black; mandibles, clypeus, and a spot between bases of antennae yellowish; scape black, pale at apex; remainder of antenna dark brown; all coxae and femora blackish; anterior tibiae pale, the middle and posterior pairs more or less infuscated; tarsi brownish yellow, the apical segment black; wings hyaline.

Male.—Essentially like the female except in the structure of the antennae and in color. Antennae 12-segmented; pedicel and basal three flagellar segments subequal, slightly longer than broad, fourth to ninth flagellar segments shorter, moniliform; the apical segment conical. Reddish yellow; antennae and legs a little paler; apical half of abdomen more or less blackish.

Type locality.—Takoma Park, Md.

Type.—U. S. National Museum No. 50795.

Host.—Eggs of *Ceratomia catalpae* Bdv.

Described from 32 females and 51 males (type, allotype, and paratypes) reared by J. W. Bulger at the type locality September 27, 1932; and 2 females and 3 males, likewise reared from eggs of *C. catalpae*, by W. J. Baerg, August 5, 1933, at Fayetteville, Ark.

ICHNEUMONOIDEA

BRACONIDAE

Apanteles epiblemae, new species

This species is exceedingly similar to *epinotiae* Viereck, with which it is easily confused. It may be distinguished from that species, however, by its complete and strong propodeal costulae, by its relatively longer intercubitus, by its more definitely punctate face, mesoscutum, and mesopleurum, by the prominence of the posterior lateral angles of the propodeum, and by its longer ovipositor.

Female.—Length, 2.5 mm. Head strongly transverse, temples narrow; face flat, definitely closely punctate and subopaque; malar space equal to basal width of mandible; eyes long; vertex minutely punctate, opaque; ocellocular line and postocellar line subequal, twice the diameter of an ocellus, antennae slightly shorter than body.

Thorax, stout, broader than head; mesoscutum finely confluently punctate, minutely longitudinally rugulose posteriorly; disk of scutellum longer than broad at base, smooth and polished; polished areas on lateral face of

scutellum very large, triangular, extending nearly to the base; propodeum finely rugulose, with a large, sharply margined median areola which is open at the base and is traversed by several low transverse rugae, and with strong, complete costulae; posterior lateral angles of propodeum very prominent; mesopleurum anteriorly confluently punctate and opaque; first abscissa of radius about one and one-half times as long as transverse cubitus; metacarpus distinctly longer than stigma; nervellus strongly curved; posterior coxae smooth; inner calcarium of posterior tibia hardly half as long as basitarsus.

Abdomen a little narrower than thorax; first tergite considerably longer than broad, nearly parallel sided, truncate at apex, closely rugulose; plate of second tergite strongly transverse, longest at the middle, its median length about one-fourth its apical width, very weakly, indefinitely sculptured; third and following tergites polished, the third much longer than the second; ovipositor sheath slender, fully as long as the abdomen and as long as posterior tarsus.

Black; palpi pale; anterior legs beyond trochanters testaceous; middle femora apically, middle tibiae and posterior tibiae, except at apex, and middle tarsi, except apical segment, reddish-yellow; tegulae yellowish-white; wings whitish hyaline; stigma hyaline margined with brown; veins mostly hyaline; costa whitish; metacarpus brown.

Male.—Like the female in all essential respects; however, the second tergite is smoother, the legs, especially the middle and posterior tibiae, are darker; and the antennae are longer than the body.

Type locality.—Meade County, Kans.

Type.—U. S. National Museum No. 50796.

Host.—*Epiplema strenuana* Walker.

Described from 7 females and 6 males. The type, allotype, and one male and one female paratype reared in February 1933 from the above-named host at the type locality by Sam G. Kelly; three males and one female from Clark County, Kans., likewise reared by Mr. Kelly in February 1933; one male from Riley County, Kans., and one female from Manhattan, Kans., reared by Mr. Kelly in August 1933; one female from Bridgeville, Del., reared from *E. strenuana* by A. O. Baker, August 10, 1933; one female reared from the same host by William Rau Haden at Camden, Del., August 14, 1933; and one female reared from *Grapholitha molesta* Busck by O. I. Snapp, of the Bureau of Entomology and Plant Quarantine, at Fort Valley, Ga., June 16, 1925, under Quaintance No. 21938. In the female paratypes the color of the legs ranges from almost entirely testaceous beyond trochanters to mostly black.

Apanteles thujae, new species

In my key to the Nearctic species of *Apanteles*[2] this species runs directly to *monticola* Ashmead, which it very closely resembles. It may be distinguished from that species, however, by its somewhat depressed thorax, shorter malar space, punctate scutellum, and the rugulose punctate, rather than more or less striate, sculpture of the basal two abdominal tergites.

Female.—Length, 1.8 mm. Head slightly narrower than thorax; eyes a little convergent below; malar space shorter than basal width of mandible; face smooth and shining, with only indistinct setiferous punctures; temples narrow but convex; ocell-ocular line twice diameter of an ocellus; antennae about as long as body.

[2] Proc. U. S. Nat. Mus. 58: 487. 1920.

Thorax stout, distinctly somewhat depressed; mesoscutum broader than long, opaque, evenly, minutely, and shallowly punctate; suture at base of scutellum very narrow, minutely foveolate; scutellum flat, subopaque, sculptured like mesoscutum though more weakly; propodeum convex, more than twice as broad as long, without a median areola, smooth and shining, with only a little weak rugulosity along posterior margin; mesopleurum smooth and polished except anteriorly, where there are some shallow punctures; inner calcarium of posterior tibia not longer than outer and not quite half as long as metatarsus; stigma slightly shorter than metacarpus; radius issuing from middle of stigma, perpendicular to anterior margin of wing and slightly longer than intercubitus.

Abdomen narrower than thorax; chitinized plate of first tergite narrowing a little toward apex, twice as long as broad at apex, gently excavated at base, where it is smooth and polished, the apical two-thirds finely rugulose punctate, and with a more or less distinct, though very narrow and shallow, median longitudinal groove on posterior half; lateral membranous margins of first tergite very broad on apical half; plate of second tergite strongly transverse, more than three times as broad on posterior margin as long, defined laterally by indistinct oblique grooves, more weakly sculptured than first tergite, its posterior margin straight; following tergites smooth and shining; ovipositor sheath at least as long as posterior femur but hardly as long as posterior tibia, rather strongly broadened toward apex; ovipositor a little decurved at apex.

Black; antennae entirely black, also tegulae; apex of anterior femur, more or less of anterior tibia, the anterior and middle tarsi, and posterior tibia at extreme base, yellowish brown; calcaria of tibiae whitish; wings clear hyaline, stigma and veins brown.

Male.—Essentially like female, but having antennae considerably longer than body.

Type locality.—Bar Harbor, Maine.

Type.—U. S. National Museum No. 50797.

Host.—*Recurvaria thujaella* Kearfott.

Described from seventeen females and one male (Type, allotype, and 16 paratypes) reared by A. E. Brower at type locality July 15–19, 1933, and two females, likewise reared by Dr. Brower, July 8, 1933, at Mt. Desert Island, Maine.

(*Macrocentrus laspeyresiae* Mues.) = *Macrocentrus instabilis* Mues.

Macrocentrus instabilis Muesebeck, Proc. U. S. Nat. Mus. **80**: 34. 1932.
Macrocentrus laspeyresiae Muesebeck, loc. cit., p. 37 (new synonymy).

Since the publication of the paper in which *instabilis* and *laspeyresiae* were described I have seen a large number of additional specimens, reared from *Grapholitha molesta* Busck and *Carpocapsa pomonella* L. This material exhibits complete intergradations between typical *instabilis* and typical *laspeyresiae*, and has convinced me that the two are merely variants of an extremely variable species.

(*Aneurobracon* Brues) = *Mesocoelus* Schulz

Coelothorax Ashmead (not *Coelothorax* Anceys). Proc. Ent. Soc. Wash. **4**: 165. 1898.

Mesocoelus Schulz, Zool. Ann. **4**: 88. 1911.

Aneurobracon Brues, The African Republic of Liberia and the Belgian Congo, based on the Harvard African Expedition, **2**: 1002 (new synonymy).

Mesocoelus Muesebeck, Proc. Biol. Soc. Wash. **45**: 227. 1932.

At the time of my brief discussion of this genus I had not seen the paper by Brues in which *Aneurobracon* was described. His description and figures leave no doubt that the genotypic species, *Aneurobracon bequaerti*, is congeneric with the genotype of *Mesocoelus*. It appears to be very similar to *philippinensis* Mues., but differs in the complete absence of a medius and the slightly longer antennae.

ENTOLOMOGY.—*An undescribed rubber tingitid from Brazil (Hemiptera).*[1] C. J. DRAKE and M. E. POOR, Iowa State College. (Communicated by HAROLD MORRISON.)

Through the kindness of Mr. H. G. Barber of the U. S. Bureau of Entomology, the writers have received a series of 40 specimens of an undescribed species of lace bug from Brazil. The insect was taken in large numbers on the leaves of the rubber tree, *Hevea braziliensis* Muell. Arg.

Leptopharsa heveae, sp. nov. Fig. 1.

Elongate, moderately broad, whitish. Antennae very long, dark brown to brownish black, clothed with numerous fine, short, pale hairs; segment I long, moderately stout, almost straight, nearly six times as long as II, the latter very short; III very long, slender, nearly straight, two and a half times the length of one; IV very long, slender, scarcely stouter than three, clothed with longer hairs, one and one-half times the length of one. Head brown, largely covered with whitish exudation, armed with five long, pale testaceous spines; frontal spines sub-porrect, blunt, the tips contiguous; median and lateral spines more or less resting on the surface of the head. Bucculae whitish, reticulate, closed in front. Rostral laminae widely separated on meso- and metanotum; rostrum extending on the basal portion of mesosternum. Orifice distinct.

Body beneath ferrugineous, more or less covered with whitish exudation. Legs long, slender, testaceous, the tarsi darker. Pronotum moderately tumid, deeply and closely pitted, reticulate on triangular portion, tricarinate; median carina thicker and more strongly elevated, without distinct areolae; lateral carinae distinct, sub-parallel, faintly converging posteriorly. Paranota moderately broad, biseriate, moderately reflexed, the lateral margin rounded and finely serrate. Collum distinct, raised at the middle, reticulate. Calli black, often covered with white exudation. Elytra widening posteriorly, finely serrate along the costal margin, extending considerably beyond tip of abdomen, the areolae not very large and clear; costal area broad, mostly quadriseriate, with five rows at widest part, the areolae not arranged in very regular rows; subcostal area narrow, biseriate; discoidal area moderately

[1] Received March 22, 1935.

large, faintly impressed, not quite reaching middle of elytra, narrowed at apex, with five to six rows of areolae at widest part; sutural area rather widely reticulated. Wings subequal to abdomen in length.

Length, 4.00–4.20 mm.; width, 1.35–1.50 mm.

Fig. 1.—*Leptopharsa heveae* sp. nov., *type*, ♂.

Holotype, male, and allotype, female, Boa Vista Rio Tapajo, Brazil, on leaves of rubber tree, collected by Dr. C. H. T. Townsend. Paratypes, taken with type and from Para, Brazil, on rubber tree, taken by H. W. Moore. Types in U. S. National Museum.

This is the first record of a tingitid pest of the rubber plant. It is a very distinct species and probably most closely allied to *L. abella* Drake from Brazil. From the latter or other closely allied forms, *L. heveae* may be distinguished by its larger size, white color and wider costal area. The genus *Leptopharsa* Stål contains about 70 described species, largely from tropical America.

BOTANY.—*The genus* Cremosperma.[1] C. V. MORTON, National Museum. (Communicated by WILLIAM R. MAXON.)

Bentham's genus *Cremosperma* has always been considered as doubtfully valid. Thus, Hanstein in his monograph of the family Gesneriaceae[2] listed it among the dubious genera; Bentham and Hooker[3] reduced it to a section of *Besleria;* and Fritsch,[4] although he

[1] Published by permission of the Secretary of the Smithsonian Institution. Received March 11, 1935.

[2] Linnaea 34: 429. 1865.

had seen no specimens, listed it a doubtful genus related to *Besleria*. Very recently Fritsch[5] has described as new *Besleria* (*Cremosperma*) *cinnabarina*, reducing the genus to *Besleria* outright.

For some time I have been engaged in a monographic study of *Besleria* and have had an opportunity to examine most of the species. During this investigation I came across numerous specimens of *Cremosperma*, which had been variously identified as belonging to the genera *Besleria*, *Episcia*, *Achimenes*, *Tydaea*, and *Koellikeria*, all of which (with the exception of *Besleria*) are quite remotely related. These specimens, all from the Andes of Colombia and Ecuador, were distinguished by a low herbaceous habit and a distinctive racemose-capitate inflorescence, and were obviously congeneric with Bentham's *Cremosperma hirsutissimum*.

Further study has convinced me that *Cremosperma* represents a perfectly valid generic type, perhaps of not even very close affinity with *Besleria* in spite of the similar disk and anthers of both. In addition to a very different habit and inflorescence, the species of *Cremosperma* all have small, usually pale-colored corollas with widely flaring limb and usually non-ventricose tube. The usually highly colored corollas of *Besleria* have a small inconspicuous limb except in the two species belonging to the subgenus *Macrobesleria*, in which the corolla lobes are larger and patent; in these two species, however, the corolla tube is markedly ventricose and the plants are otherwise very different from *Cremosperma*. The calyx also differs from that of any species of *Besleria*, being turbinate or cylindric-turbinate with short equal lobes and ten conspicuous costae, these in a few species sometimes obscured by the dense pubescence. The fruits of *Cremosperma* will apparently afford technical characters of importance also. Those of *Besleria* are fleshy berries with a thick skin. Bentham originally described those of *Cremosperma* as capsules opening by two valves, but an examination of the few mature fruits available indicates rather that they are capsules with thin membranous walls, not really two-valved but rupturing irregularly. I have not been able to study any mature seeds.

The number of species must now be increased from two to ten and there are indications that further exploration of Colombia will reveal still others. The species are apparently very local in distribution and many are known from a single collection only.

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[3] Genera Plantarum **2**: 1016. 1876.
[4] Engl. & Prantl. Pflanzenfam. **4**[3b]: 159. 1895.
[5] Notizbl. Bot. Gart. Berlin **11**: 976. 1934.

Cremosperma Benth.[6]

Herbae perennes vel fruticuli perpusilli, caulibus erectis vel adscendentibus vel repentibus. Folia opposita vel quaternata, aequalia vel inaequalia, saepe ovata vel elliptica, interdum orbicularia vel oblanceolata, plerumque basi subcordata, saepe hirsuta, petiolata, paucinervata. Inflorescentia racemoso-capitata (vel raro flores solitarii?). Pedunculus communis brevis vel elongatus. Calyx tubulosus, turbinatus vel cylindrico-turbinatus, 10-costatus, lobis parvis, erectis, integris, acutis. Corolla alba, flava vel raro rubescens vel coccinea (?), parva, tubo cylindrico vel infundibuliformi, lobis magnis, patentibus, rotundatis. Stamina 4, didynama, loculis confluentibus. Annulus hypogynus annularis vel semi-annularis, glandulis discretis nullis. Ovarium glabrum. Capsula subglobosa, membranacea, irregulariter dehiscens.

TYPE SPECIES: *Cremosperma hirsutissimum* Benth.

KEY TO SPECIES

Flowers racemose-capitate on a common peduncle. Mostly lowland species.
Leaves mostly borne in whorls of 3 or 4, equal, acute at base and apex.
Corolla white, the tube ampliate upwardly; calyx lobes deltoid.. ..... **1. C. pusillum.**
Leaves opposite, never in whorls.
Leaves of a pair unequal, the smaller one much reduced, sometimes auriculiform; corolla tube hardly at all ampliate.
Larger leaves oblanceolate, acute at base, glabrate above; calyx lobes ovate-deltoid; disk reduced to a bilobed posterior gland.... ..... **2. C. congruens.**
Larger leaves obliquely oval, obliquely subcordate at base, densely sericeous-pilose above; calyx lobes linear-lanceolate; disk annular..... **3. C. cotejense.**
Leaves of a pair equal, subcordate or rounded at base; corolla tube ampliate (except in *C. Castroanum*).
Calyx glabrous, except for the ciliate lobes, glaucous; common peduncle about 10 cm. long; corolla reddish, glabrous..... ..... **4. C. jucundum.**
Calyx hirsute or hirsutulous, not glaucous; common peduncle not more than 5 cm. long; corolla white or yellow, pilose.
Corolla 8–10 mm. long, yellow, the lobes 1.5–2 mm. long. Leaves ovate or elliptic, not tuberculate above.
Leaves glabrous above; calyx lobes deltoid, much shorter than the calyx tube..... **5. C. ignotum.**
Leaves hirsute above; calyx lobes lanceolate, almost equaling the calyx tube..... **6. C. Castroanum.**
Corolla 12–15 mm. long, the lobes 3–6 mm. long.
Calyx about 8.5 mm. long.
Leaves elongate-tuberculate above, about 4.5 cm. long; calyx lobes linear-lanceolate..... **7. C. nobile.**

[6] Plant. Hartw. 234. 1846.

Leaves not tuberculate above, 7.5–8.5 cm. long; calyx lobes oblong.....**8. C. hirsutissimum.**

Calyx about 5.5 mm. long, the lobes ovate, broad. Leaves not tuberculate above, suborbicular, up to 6.2 cm. wide; corolla white.....**9. C. album.**

Flowers aggregate in the leaf axils, a common peduncle absent. Calyx deeply parted, the lobes lanceolate; corolla deep red. High mountain species. .....**10. C. cinnabarinum.**

1. **Cremosperma pusillum** Morton, sp. nov.

Frutex pusillus, usque ad 20 cm. altus; caules crassi, teretes, hirsuti, internodiis brevissimis, nodis perspicuis; folia ternata vel quaternata, aequalia, parva, lamina anguste elliptica, maxima ca. 20 mm. longa et 7 mm. lata, evidenter crenata, basi apiceque acuta, supra sparse hirsuta, saepe bullata, subtus reticulata, imprimis in nervis villosa (nervis secundariis 4 vel 5 jugis), petiolata, petiolo usque ad 15 mm. longo, hirsuto, gracili; pedunculus communis tenuis, usque ad 3 cm. longus, glaber vel sparse pilosus; flores racemoso-capitati, pauci, pedicellis usque ad 4 mm. longis, parce pilosis; calyx campanulatus, ca. 5 mm. longus, sparse pilosus, tubo 2.5–3 mm. longo, lobis deltoideis, obtusis; corolla alba, erecta, tubo cylindrico, ca. 11 mm. longo, ca. 2 mm. lato, sursum ampliato et ca. 4 mm. lato, extus glabro vel parce piloso, lobis magnis, ca. 5 mm. longis et 4 mm. latis, patentibus, rotundatis, utrinque glabris; ovarium glabrum; stylus glaber; discus tenuis, altus, uno latere interruptus; fructus deest.

Type in the Kew Herbarium, collected at Tambo de Savanilla, probably Province of Nariño, Colombia, Dec. 18, 1876, by E. André (no. 4572); duplicate in the New York Botanical Garden. A second collection of this species is *Kalbreyer* 1470, in the Kew Herbarium, collected in the Province of Antioquia, Colombia. This agrees in all particulars with the André specimens.

Easily distinguishable by its very small ternate or quaternate leaves, in contrast to strictly opposite leaves of the other species.

A somewhat larger specimen collected in Ecuador by Jameson appears varietally distinct:

var. **ecuadorense** Morton, var. nov.

Differt a var. *typica* foliis majoribus (usque ad 5.3 cm. longis et 2.7 cm. latis), magis hirsutis, calycibus longioribus (ca. 9 mm. longis) et disco annulari nec interrupto.

Type in the Kew Herbarium, collected on Mt. Pichincha, Ecuador, ca. 1,800 meters altitude, Jan. 21, 1856, by W. Jameson.

2. **Cremosperma congruens** Morton, sp. nov.

Herba parva, usque ad 15 cm. alta; caules teretes, strigosi, internodiis brevibus; folia opposita, cujusve paris saepe valde inaequalia, alterum lamina oblanceolata, usque ad 3.5 cm. longa et 1.4 cm. lata, apicem versus serrata, acuta, basi attenuata, supra primum parce pilosa, mox glabrata, subtus imprimis in nervis strigosa (nervis secundariis ca. 6 jugis), petiolata (petiolo brevi, usque ad 3 mm. longo, strigoso), alterum parvum vel auri-

culiforme, lanceolatum, integrum, vix petiolatum; pedunculus communis tenuis, usque ad 27 mm. longus, glaber vel parce pilosus; flores racemoso-capitati, pedicellis brevibus vel usque ad 7 mm. longis, pilosis; calyx turbinatus, 4.5 mm. longus, sericeo-strigosus, tubo 3.5–4 mm. longo. intus glabro, lobis ovato-deltoideis, obtusis; corollae tubus erectus, cylindricus, ca. 7 mm. longus et 1.5 mm. latus sursum non ampliatus, extus pilosus, lobis magnis, ca. 3 mm. longis et 2 mm. latis, patentibus, rotundatis; filamenta libera, glabra; antherae parvae, connatae; ovarium globossum, glabrum; stylus glaber; stigma capitatum; discus in glandulam posticam bilobam reductus.

Type in the U. S. National Herbarium, no. 1,185,005, collected at Paime, Department of Cundinamarca, Colombia, altitude about 1,000 meters, by Brother Ariste Joseph (no. A923). There is in the Hooker Herbarium at Kew another specimen of this species collected at the same locality by Goudot.

3. Cremosperma cotejense Morton, sp. nov.

Herba parva, usque ad 30 cm. alta; caules crassi, teretes, sparse pilosi; folia herbacea, cujusve paris valde inaequalia, alterum oblique ovale, usque ad 6 cm. longum et 2.5 cm. latum, serratum, apice acutum, basi oblique subcordatum, supra dense pilosum, subtus imprimis in nervis pilosum (nervis secundariis ca. 4 jugis), petiolatum, petiolis gracilibus, usque 12 mm. longis, alterum auriculiforme, ca. 8 mm. longum, parum serratum, vix acutum, basi subcordatum, vix petiolatum; pedunculus communis usque ad 2.5 cm. longus gracilis, sparse pilosus; flores racemoso-capitati, pedicellis brevissimis, ca. 2 mm. longis, gracilibus, sparse pilosis; calycis tubus ca. 2 mm. longus, angustus, extus hirsutus, intus glaber, lobis lineari-lanceolatis, ca. 2 mm. longis, hirsutis; corollae tubus ca. 4 mm. longus, ca. 1 mm. latus, anguste cylindricus, sursum vix ampliatus, glaber, in calyce inclusus, lobis ca. 3 mm. longis, patentibus, albis, extus pilosis; antherae in fauce dispositae, connatae, parvae; filamenta glabra; ovarium glabrum; stylus glaber; discus annularis, integer, glaber; fructus deest.

Type in herbarium of the New York Botanical Garden, collected in dense, damp forests around Coteje on Rio Timbiqué, Province of Cauca, Colombia, altitude 100–500 meters, by F. C. Lehmann (no. 8888).

Lehmann's field note reads as follows: "Stems up to 30 cm. in length, poorly ramified, procumbent at base. Leaves soft herbaceous, black-green, on the upper side with a greasy sheen. Flowers white."

4. Cremosperma jucundum Morton, sp. nov.

Herba vix 15 cm. alta; caules crassi, teretes, lanati; folia opposita, fere aequalia, lamina ovata, usque ad 10 cm. longa et 6 cm. lata, membranacea, leviter crenata, apice rotundata, basi subcordata, supra hirsuta, paullulum bullata vel tuberculata, subtus imprimis in nervis lanata, nervis secundariis ca. 6 jugis; petiolus brevis, usque ad 7 mm. longus, crassus, dense hirsutus; pedunculus communis elongatus, usque ad 10 cm. longus, gracilis, hirsutus; flores racemosi-capitati, numerosi, pedicellis ca. 6 mm. longis, fere glabris, glaucescentibus, apice incrassatis; calyx campanulato-turbinatus, ca. 4.5 mm. longus, glaber, glaucus, lobis deltoideis, ciliatis; corolla rubescens, glabra, ca. 11 mm. longa, tubo cylindrico, sursum gradatim ampliato, non ventricoso, lobis magnis, patentibus, rotundatis; ovarium glabrum; discus annularis, integer, glaber.

Type in the Kew Herbarium, collected in the Province of Antioquia, Colombia, in 1879, by Kalbreyer (no. 1821). Kalbreyer's field note reads: "Herb in tufts; leaf blackish-green with velvety lustre; flowers in umbels, reddish. Forest shade, 2,700–3,000 feet."

5. Cremosperma ignotum Morton, sp. nov.

Herba parva, usque ad 9 cm. alta, caules perbreves, lanati; folia opposita, cujusve paris aequalia, elliptica, maxima 5.8 cm. longa et 3.2 (raro 3.8) cm. lata, membranacea, integra vel parum denticulata, apice acuta vel rotundata, basi subcordata, supra glabra, subtus imprimis in nervis appresso-pubescentia (nervis secundariis ca. 4 jugis), breviter peticlata, petiolo crasso, ca. 7 mm. longo, lanato; pedunculus communis tenuis, usque ad 4 cm. longus, fere glaber vel parce pilosus; flores racemoso-capitati, pedicellis brevibus vel usque ad 3.5 mm. longis, pilosis; calyx turbinatus, ca. 3.5 mm. longus, 10-costatus, imprimis in costis strigosus, tubo ca. 2.5 mm. longo, lobis ca. 1 mm. longis, deltoideis, acutis, paullulum inaequalibus; corolla flava, 8–10 mm. longa, extus parce pilosa, tubo cylindrico, fauce ampliato, lobis ca. 2 mm. longis, patentibus, rotundatis; antherae parvae, connatae; ovarium glabrum; discus annularis, altus, integer; fructus deest.

Type in the herbarium of the Academy of Natural Sciences, Philadelphia, no. 642,556, collected in forest along Rio Caballete, Santa Rosa, Dagua Valley, Department of El Valle, Colombia, altitude 200–300 meters, Sept. 22, 1922, by E. P. Killip (no. 11540). A duplicate is in the herbarium of the New York Botanical Garden.

6. Cremosperma Castroanum Morton, sp. nov.

Herba erecta, usque ad 20 cm. alta; caules crassi, teretes, dense hirsuti; folia opposita, aequalia, lamina ovata vel elliptica, usque ad 9.5 cm. longa et 6 cm. lata, membranacea, dentata, apice late obtusa vel rotundata, basi rotundata, supra hirsuta, plana, subtus pilosa, nervis secundariis ca. 5 jugis; petiolus usque ad 3 cm. longus, hirsutus; pedunculus communis usque ad 5 cm. longus, tenuis, pilosus; flores racemoso-capitati, numerosi, pedicellis brevissimis, 2–2.5 mm. longis, pilosis; calyx cylindrico-turbinatus, ca. 5 mm. longus, hirsutus, intus glaber, lobis lanceolatis, tubum fere aequantibus; corolla flava, parva (usque ad 8.5 mm. longa), sparse pilosa, tubo cylindrico, ca. 2 mm. lato, sursum vix ampliato, lobis semioblongis, 1.5 mm. longis, rotundatis, patentibus; filamenta tenuia, glabra; antherae parvae; ovarium glabrum, stylus glaber; stigma capitatum; discus annularis, brevis, integer, glaber.

Type in the U. S. National Herbarium, no. 1,517,374, collected at Tutunendo, 20 kilometers north of Quibdó, Intendencia de Chocó, Colombia, altitude 80 meters, May 19–20, 1931, by W. A. Archer (no. 2151). I have seen the following additional collections, all from the Intendencia de Chocó: *Triana* 2546; *R. B. White* s. n.; La Concepción, 15 kilometers east of Quibdó, *Archer* 1998, 1970.

Named in honor of Señor Rudolfo Castro, of Quibdó, who was of great assistance to Dr. Archer during his stay in Colombia.

Similar in aspect to *C. album* Morton, with which it grows, but easily distinguishable by its very small yellow corollas. The corolla tube is cylindric and hardly at all widened upwardly. The larger, white corollas of *C. album* have a markedly ampliate corolla tube and very wide throat.

7. Cremosperma nobile Morton, sp. nov.

Herba parva, vix 20 cm. alta; caules crassi, teretes, dense lanati; lamina foliorum ovata, maxima ca. 4.5 cm. longa et 3 cm. lata, plus minusve crassa, apice acuta, basi rotundata, perspicue crenata, supra hirsuta, elongato-tuberculata, subtus hirsuta, nervis secundariis 5–8 jugis; petiolus crassus, usque ad 2 cm. longus, dense lanatus; pedunculus communis crassus, brevis, ca. 12 mm. longus, dense lanatus; flores racemoso-capitati, pedicellis brevissimis, paucis, hirsutis; calycis tubus ca. 3.5 mm. longus, extus hirsutus, intus glaber, lobis lineari-lanceolatis, ca. 5 mm. longis, acuminatis, extus hirsutis; corollae tubus gracilis, ca. 8 mm. longus, anguste cylindricus, ca. 1 mm. latus, sursum gradatum ampliatus, ca. 1.5 mm. latus, glaber, lobis magnis, ca. 6 mm. longis, patentibus, extus pilosis; ovarium cylindricum, glabrum; discus annularis, integer, glaber; fructus deest.

Type in herbarium of the New York Botanical Garden, collected at Armada, Province of Nariño, Colombia, May 22, 1876, by E. André (no. K43).

A peculiar species by reason of the elongate-tuberculate upper surfaces of the leaves, in which respect it is analogous to *Besleria princeps* Hanst.

8. CREMOSPERMA HIRSUTISSIMUM Benth. Plant. Hartw. 234. 1846.

Founded on a Hartweg specimen collected in the Andes of Popayán, Colombia. This, the type species of the genus, has not since been recollected.

9. Cremosperma album Morton, sp. nov.

Herba repens, usque ad. 20 cm. alta; caules teretes, crassi, hirsuti; folia opposita, aequalia, lamina suborbiculari, maxima ca. 9 cm. longa et 6.2 cm. lata, membranacea, apice dentata vel subintegra, late rotundata, basi subcordata, supra hirsuta, subtus imprimis in nervis hirsuta, nervis secundariis ca. 5 jugis; petiolus crassus, hirsutus, usque ad 2.2 cm. longus; pedunculus communis usque ad 4 cm. longus, dense hirsutus; flores racemoso-capitati, numerosi, pedicellis brevibus, 1.5–3.5 mm. longis, hirsutis; calyx late turbinatus, ca. 5.5 mm. longus, hirsutus, lobis ovatis, latis; corolla alba, 12–15 mm. longa, pilosa, tubo basi cylindrico, ca. 2 mm. lato, sursum subito ampliato et 8 mm. lato, lobis magnis, ca. 3 mm. longis, patentibus, late rotundatis, ovarium glabrum; discus annularis, altus, irregulariter erosus, glaber.

Type in the herbarium of the Academy of Natural Sciences, Philadelphia, no. 642,503, collected at Córdoba, Dagua Valley, Department of El Valle, Colombia, altitude 80–100 meters, May 8, 1922, by E. P. Killip (no. 5242). Duplicates in the Gray Herbarium, the herbarium of the New York Botanical Garden, and the U. S. National Herbarium. An additional specimen was collected in the Intendencia de Chocó by Triana.

10. Cremosperma cinnabarinum (Fritsch) Morton, comb. nov.

Besleria (*Cremosperma*) *cinnabarina* Fritsch, Notizbl. Bot. Gart. Berlin. 11. 976. 1934.

Type collected in glades of dense forests in the Montaña de Caramanta, Dept. of El Valle, Colombia, August, 1891, altitude 2,300–2,600 meters, by F. C. Lehmann (no. 7441).

The present species, of which I have seen no material, may not be congeneric with those above described, the axillary flowers, as well as the corolla color, being anomalous. The habit also is apparently different, the stem being described as up to one meter long, whereas the stems of none of the other species exceed 30 cm. in length. Lehmann's note is as follows: "Weed with fleshy stems up to 1 m. in height. Leaves dull yellow green. Flowers light vermilion."

BOTANY.—*A new species of* Maurandia *from Death Valley.*[1] FREDERICK V. COVILLE and C. V. MORTON, U. S. NATIONAL HERBARIUM.

The genus *Maurandia* of the family Scrophulariaceae consists, according to the monograph[2] by Prof. P. A. Munz of Pomona College, of eight species, all natives of Mexico with the exception of *M. antirrhiniflora* H. & B., a peculiar species which has been shifted back and forth between *Maurandia* and *Antirrhinum* for many years. At the time of publication of this monograph *M. antirrhiniflora* was the only species known from the United States, but shortly thereafter a second species, *M. acerifolia*[3] Pennell, was described from Arizona. During the course of field work in Death Valley under the auspices of the National Geographic Society the senior author in company with Mr. M. French Gilman found a plant of this alliance which at first was considered to represent a new generic type, because of its one-celled ovaries and capsules. Later collections by Mr. Gilman have shown, however, that occasionally both cells of the ovary are fully developed and fertile. It has seemed best, therefore, to consider this plant, despite its peculiar characters, as a new species of *Maurandia*, although future studies may show that it is as distinct generically as *Epixiphium* and *Rhodochiton*, monotypic genera segregated from *Maurandia*.

That our knowledge of the flora of the arid Southwest is as yet far from complete is well shown by the fact that the only yellow-flowered species of *Maurandia* known, viz., *M. flaviflora*, *M. acerifolia*, and *M. petrophila*, have all been discovered within the last few years. *M. petrophila* does not resemble the other two very closely.

The original specimens were growing in a crevice of the north-facing, vertical rock wall of Titus Canyon, composed at that point of a almost white limestone.

[1] Published by permission of the Secretary of the Smithsonian Institution. Received April 30, 1935.

[2] *The Antirrhinoideae-Antirrhineae of the New World.* Proc. Calif. Acad. Sci. IV. 15: 323–397. 1926.

[3] This JOURNAL 19: 69. 1929.

Maurandia petrophila Coville & Morton, sp. nov.
(Type specimen; about two-thirds natural size)

Maurandia petrophila Coville & Morton, sp. nov.

Section *Lophospermum*. Herba perennans, erecta, usque ad 17 cm. alta, basi ramosa; caules pallido-virides, ca. 2 mm. diametro, villosuli, pilis hyalinis articulatis eglandulosis, internodiis saepissime brevibus; folia alterna, petiolata, petiolis usque ad 3 cm. longis, villosulis, apice dilatatis; laminae

ambitu suborbiculares, usque ad 3 cm. longae et latae, membranaceae, pallido-virides, basi in petiolum attenuatae, apice rotundatae vel acutae, margine irregulariter et acriter spinuloso-dentatae, utrinque molliter villosulae; flores in axillis foliorum solitarii, pedicellati, pedicellis brevissimis; calycis segmenta fere libera, lineari-lanceolata, per anthesin usque ad 15 mm. longa et 2.5 mm. lata, acuminata, margine valde spinulosa, pallido-viridia, utrinque villosula; corolla lutea, tubulosa, usque ad 3.5 cm. longa, basi non saccata, tubo ca. 5 mm. lato, extus fere glabro vel apicem versus villosulo, intus glabro vel pilis paucis hyalinis praedito, sursum gradatim ampliato, fauce 7–9 mm. lato, plicis duobus aurantiacis vix puberulis instructo, lobis patentibus, magnis, usque 9 mm. longis, imbricatis, basi paullulum angustatis, apice late rotundatis, integris; stamina 4, didynama, inclusa, filamentis sparse stipitato-glandulosis, apice recurvatis, antheris semicircularibus, loculis explanatis, discretis, glabris; staminodium nullum; ovarium glabrum, ovoideum; stylus tenuis, glaber; discus hypogynus brevis, annularis; capsula sphaeroidea, ca. 9 mm. diametro, glabra, stylo peristente coronata, unilocularis (loculo altero abortivo, sterili) vel rarissime bilocularis, placenta magna intrusa persistente, irregulariter apice dehiscens, textura membranacea; semina numerosa, subpyramidalia, ca. 2.5 mm. longa, 2 mm. apice lata, pallido-flava vel cinerea, apice alulis brevissimis non nunquam transversalibus praedita, dense tuberculata, tuberculis spongiosis, in lineis irregularibus longitudinalibus dispositis.

Type in the U. S. National Herbarium, no. 1,565,465, collected in Titus Canyon, Grapevine Mountains, Death Valley, California, April 25, 1932, at 2100 feet elevation, by Frederick V. Coville and M. French Gilman (no. 441). Mr. Gilman has since collected this species at the type locality, on April 17 and April 29, 1934 (*Gilman* nos. 1108 and 1195 respectively).

The following key will serve to separate the present species from *M. acerifolia:*

Leaves conspicuously spinulose, suborbicular; pedicels very short; corolla up to 35 mm. long; calyx lobes linear-lanceolate, spinulose; seeds pale, about 2.5 mm. long..... **M. petrophila.**

Leaves shallowly dentate or lobed, cordate or reniform; pedicels 10–20 mm. long; corolla up to 22 mm. long; calyx lobes triangular-ovate, entire; seeds gray or blackish, 1–1.5 mm. long..... **M. acerifolia.**

SCIENTIFIC NOTES AND NEWS

Prepared by Science Service

NOTES

U. S. Department of Agriculture.—A systematic search for the best existing strains of cultivated plants and domestic animals has been undertaken by the Department, in cooperation with the 48 state agricultural experiment stations, genetics research institutions in foreign countries, and private plant and animal breeders. The initial task undertaken is the compiling of a catalog of plant and animal *superior germ plasms*. A committee under the chairmanship of O. E. REED, chief of the Bureau of Dairy Industry, and including Dr. A. F. BLAKESLEE of the Carnegie Institution of Washington, is now assembling and analyzing a mass of data from experiment stations and elsewhere. The results of this analysis will appear in the 1936 Yearbook of the Department of Agriculture. The next step will be to concentrate on those plant and animal problems most capable of solution by genetic improvement, and to work out effective research methods. The final step involves distribution of breeding stocks to the best possible advantage.

U. S. National Park Service.—Late in April Assistant Director HAROLD C. BRYANT made a tour of inspection of the Great Smoky Mountains National Park with a view to laying the ground work for educational activities to be carried on when that area receives full national park status. It is the opinion that trips afield to study plant and animal life will become very popular with visitors because of the wide variety and unique forms to be found there.

Park naturalist ARTHUR STUPKA of Acadia National Park has been detailed to the National Capital Parks Office for a period of six weeks to institute a series of educational programs similar to those given last Spring. A complete series of field trips and campfire programs in Rock Creek Park has been arranged.

National Bureau of Standards.—Dr. LYMAN J. BRIGGS, Director of the National Bureau of Standards, is serving as chairman of the advisory committee of the 1935 stratosphere flight, under the auspices of the National Geographic Society and the U. S. Army Air Corps. Dr. BRIGGS left Washington on May 28, to deliver the baccalaureate address at the South Dakota State School of Mines, Rapid City, S. D., on May 30, before proceeding to the stratocamp in time to supervise the final arrangements for the flight which will take place on the first favorable opportunity after June first.

Dr. F. L. MOHLER of the optics division of the National Bureau of Standards spent the week of May 5 in Rochester, N. Y., for the purpose of inspecting the two spectrographs which will be used in the 1935 stratosphere flight. The National Geographic Society has asked Dr. MOHLER to be present at the stratocamp to make the final adjustments of these instruments.

Dr. W. G. BROMBACHER is at the stratocamp at Rapid City, South Dakota, at the invitation of the National Geographic Society to assist in the installation of the instruments for measuring air pressure and air temperature. The instruments to be installed on the stratosphere balloon include a resistance thermometer, a U-tube type mercurial barometer about 6 inches high and a precision aneroid barometer of unusual design constructed this year. Dr. BROMBACHER will also serve as the directing official for the National Aeronautic Association through which organization certification is

made of the altitude attained in order to obtain international recognition.

Dr. H. C. DICKINSON, chief of the heat and power division, has been appointed to represent the National Bureau of Standards in connection with the organization of a sectional committee under A. S. A. procedure on standards for the inspection of motor vehicles, at the invitation of the American Standards Association of New York City.

U. S. Geological Survey.—The Interior Department through the Geological Survey has released the regular report of monthly and annual production of electricity for public use in the United States for 1934. This report shows for each State the monthly production of electricity for public use by the use of water power and the use of fuel and the amount of coal, oil, and gas consumed in generating electricity. The total production in 1934 was 91,150,000,000 kilowatt-hours, an increase of 6.7 per cent over the output for 1933 which in turn was 2.7 per cent above the total output for 1932. The output for 1934 was 6.4 per cent less than the record output of 97,352,000,000 kilowatt-hours in 1929.

George Washington University and Carnegie Institution of Washington.—A conference on theoretical physics was held in Washington, D. C., on April 19, 20, and 21, under the joint auspices of the Carnegie Institution of Washington and the George Washington University. This was the first of a series which it is hoped may be held annually in Washington. The discussions at this first conference were devoted to various topics in nuclear physics. Researches in this field are being conducted at the Department of Terrestrial Magnetism of the Institution and George Washington University.

In addition to interested men of science from Washington, the following were present: G. BREIT, University of Wisconsin; E. U. CONDON and R. LADENBURG, Princeton University; P. A. M. DIRAC, Princeton and Cambridge universities; S. GOUDSMIT and G. E. UHLENBECK, University of Michigan, A. LANDÉ, Ohio State University; L. NORDHEIM, Purdue University; H. A. BETHE, Cornell University; G. BECK, University of Kansas, I. I. RABI, Columbia University; O. STERN and S. A. YOUNG, Carnegie Institute of Technology; J. H. BARTLETT, University of Illinois; D. R. INGLIS, University of Pittsburgh; E. FEENBURG, Harvard University; W. K. HOUSTON, California Institute of Technology; E. O. LAWRENCE, University of California; LEO SZILARD, Oxford University; L. H. GRAY, Cambridge University.

NEWS BRIEFS

The quick healing of bad wounds brought about by fly larvae introduced into them is at least partly due to the secretion of allantoin by the larvae, Dr. WILLIAM ROBINSON of the Bureau of Entomology, U. S. Department of Agriculture, has discovered. Allantoin has long been used in the treatment of ulcers and infected wounds.

The School of Medicine of George Washington University announces the acceptance of several grants for various research projects as follows: From the Rockefeller Foundation the sum of $25,500 in support of studies in the department of biochemistry; a renewal of the Kane-Kotz Fund of $1,700 for studies on clinical endocrinology in the department of obstetrics and gynecology; from the Eli Lilly Company the sum of $1,200 for a fellowship in biochemistry, and a grant of $1,800 for the study of the post-pituitary hormones from Parke, Davis and Company.

Personal Items

Dr. Frank Rattray Lillie, of the University of Chicago and the Woods Hole Marine Biological Laboratory and Oceanographic Institute, has been elected President of the National Academy of Sciences and Chairman of the National Research Council.

Dr. Isaiah Bowman, retiring Chairman of the National Research Council, has been elected President of the Johns Hopkins University.

Dr. Vernon Kellogg, Secretary Emeritus of the National Research Council, was elected Honorary Vice President of Science Service upon his retirement from the board of trustees of that Institution. New trustees elected are: Dr. Harlow Shapley, director of Harvard College Observatory, representing the National Academy of Sciences; Dr. Henry B. Ward, permanent secretary of the American Association for the Advancement of Science, representing that institution, and Dr. Ludvig Hektoen, director of the John McCormick Institution for Infectious Diseases, representing the National Research Council.

At the commencement exercises of Washington College, Chestertown, Maryland, the degree of Doctor of Laws was conferred on Dr. John M. H. Rowland, dean of the Medical School of the University of Maryland, and on Dr. Robert L. Swain, Deputy Commissioner of Food and Drugs of Maryland and past president of the American Pharmaceutical Society.

The Walter Rathbone Bacon traveling scholarship of the Smithsonian Institution has been awarded to Dr. Richard E. Blackwelder of the U. S. National Museum, for an intensive study of the staphylinid beetles of the West Indies.